1. A method for controlling a physical dimension of a solid state structural feature comprising the steps of:

providing a solid state structure having a surface and having a structural feature;

exposing the structure to a periodic flux of ions having a characteristic ion exposure duty cycle, at a first exposure temperature; and

exposing the structure to the periodic flux of ions at a second exposure temperature that is greater than the first exposure temperature, to cause transport, within the structure including the structure surface, of material of the structure to the structural feature in response to the ion flux exposure to change at least one physical dimension of the feature substantially by locally adding material of the structure to the feature.

2. A method for controlling a physical dimension of a solid state structural feature comprising the steps of:

providing a solid state structure having a surface and having a structural feature;

exposing the structure to a periodic flux of ions having a characteristic ion exposure duty cycle, at a first ion flux; and

exposing the structure to the periodic flux of ions at a second ion flux that is less than the first ion flux, to cause transport, within the structure including the structure surface, of material of the structure to the structural feature in response to the ion flux exposure to change at least one physical dimension of the feature substantially by locally adding material of the structure to the feature.

3. A method for controlling a physical dimension of a solid state structural feature comprising the steps of:

providing a solid state structure having a surface and having a structural feature;

exposing the structure to a periodic flux of ions having a first exposure duty cycle characterized by a first ion exposure duration and a first nonexposure duration for the first duty cycle; and

exposing the structure to a periodic flux of ions having a second exposure duty cycle characterized by a second ion exposure duration and a second nonexposure duration, greater than the first nonexposure duration, for the second duty cycle, to cause transport, within the structure including the structure surface, of material of the structure to the structural feature in response to the ion flux exposure to change at least one physical dimension of the feature substantially by locally adding material of the structure to the feature.

4. A method for controlling a physical dimension of a solid state structural feature comprising the steps of:

providing a solid state structure having a surface and having a structural feature;

exposing the structure to a continuous flux of ions; and

exposing the structure to a periodic flux of ions having a duty cycle characterized by an ion exposure duration and a nonexposure duration for the duty cycle, to cause transport, within the structure including the structure surface, of material of the structure to the structural feature in response to the ion flux exposure to change at least one physical dimension of the feature substantially by locally adding material of the structure to the feature.

5. The method of any of claims 1-4 wherein the structural feature comprises an aperture.

6. The method of any of claims 1-4 wherein the structure comprises a crystalline substrate.

7. The method of any of claims 1-4 wherein the structure comprises a silicon nitride membrane.

8. The method of any of claims 1-4 wherein the structure comprises a silicon dioxide membrane.

9. The method of any of claims 1-4 wherein each periodic flux of ions comprises an ion flux duty cycle of at least about 50%.

10. A method for controlling a physical dimension of a solid state structural feature comprising the steps of:

providing a silicon dioxide membrane having a structural feature; and

exposing the silicon dioxide membrane to a periodic flux of ions having a duty cycle characterized by an ion exposure duration and a nonexposure duration for the duty cycle, to cause transport, within the silicon dioxide membrane including the membrane surface, of material of the membrane to the structural feature in response to the ion flux exposure to change at least one physical dimension of the feature substantially by locally adding material of the membrane to the feature.

11. The method of claim 10 wherein the feature comprises an aperture in the membrane.

12. A method for controlling area of an aperture in a structure comprising the steps of:

providing a solid state structure having a surface and having an aperture in the structure extending from the surface; and

exposing the structure to a periodic flux of ions having an ion exposure duty cycle characterized by an ion exposure duration, T_{on}, and a nonexposure duration, T_{off}, together selected to cause transport, within the structure including the structure surface, of material of the structure to an edge of the aperture in response to the ion flux exposure substantially by locally adding material of the structure to the aperture edge, the ion exposure and nonexposure durations being selected based on:

$$\frac{dA}{dt} = R_{ss}\left(1 - e^{-\frac{t}{\tau_{rise}}}\left(\frac{1 - e^{-\frac{T_{off}}{\tau_{decay}}}}{1 - e^{-\frac{T_{off}}{\tau_{decay}} - \frac{T_{on}}{\tau_{rise}}}}\right)\right) \quad 0 \leq t < T_{on} \ (1a)$$

$$\frac{dA}{dt} = R_{ss}\left(1 - e^{-\frac{T_{on}}{\tau_{rise}}}\left(\frac{1 - e^{-\frac{T_{off}}{\tau_{decay}}}}{1 - e^{-\frac{T_{off}}{\tau_{decay}} - \frac{T_{on}}{\tau_{rise}}}}\right)\right) e^{-\frac{(t - T_{on})}{\tau_{decay}}} \quad T_{on} \leq t \leq T_{off} \ (1b)$$

where t is time, dA/dt is a selected rate of change in aperture area, A; R_{ss} is a steady state rate of aperture area change characteristic of the structure for continuous ion flux exposure; and τ_{rise} is a material response rise time and τ_{decay} is a material response decay time characteristic of the structure under ion exposure.